California Rice

March 17, 2017

Tessa Fojut, Ph.D.
Environmental Scientist
Central Valley Regional Water
Quality Control Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670-6114

Dear Dr. Fojut:

RE: California Rice Commission Comments on the Proposed Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Pyrethroid Pesticide Discharges

The California Rice Commission (CRC) provides comments on the proposed amendments for the control of pyrethroid insecticides. Our comments provide extensive information on usage as we share our experiences with pyrethroid use and management of the referenced prohibition of discharge program and proposed 5th percentile value. Weed control is our primary pest concern with insect and disease pressure qualifying for minor use to a major crop (USDA, IR-4 2012).

From the registered pesticide labels and the Department of Pesticide Regulation (DPR) Pesticide Use Report (PUR) for full use reporting, zeta-cypermethrin and lambda cyhalothrin are the two pyrethroids applied to California rice fields. A total of eight insecticides were registered for use on California rice with the number currently at six products. Lambda cyhalothrin was first registered 1999, with zeta-cypermethrin in 2002. The two pyrethroids are never use in combination or followed in application. Usage has increased due to the lack of effectiveness resulting from no alternative insecticides for the early season insect pests. The early season insects are the most critical for rice as these are the pests that affect seeding and stand (plant) establishment.

I. Background on the CRC

The CRC is a statutory organization representing the entirety of the California rice industry consisting of 2,500 rice farmers and marketers (CDFA FAC 71000-71138). We represent the California rice industry on regulatory issues for pesticides, air and water quality, conservation programs and public education. As a commission, we do not have a membership of interested parties because our members must grow rice, market the commodity and pay a mandatory assessment to the CRC. California is the second largest rice producing state in the United States, growing mostly japonica medium grain on an average of 500,000 acres annually (CDFA). California is one of the largest organic rice producing states with approximately five percent of the total acreage in certified production.

II. Cultural practices

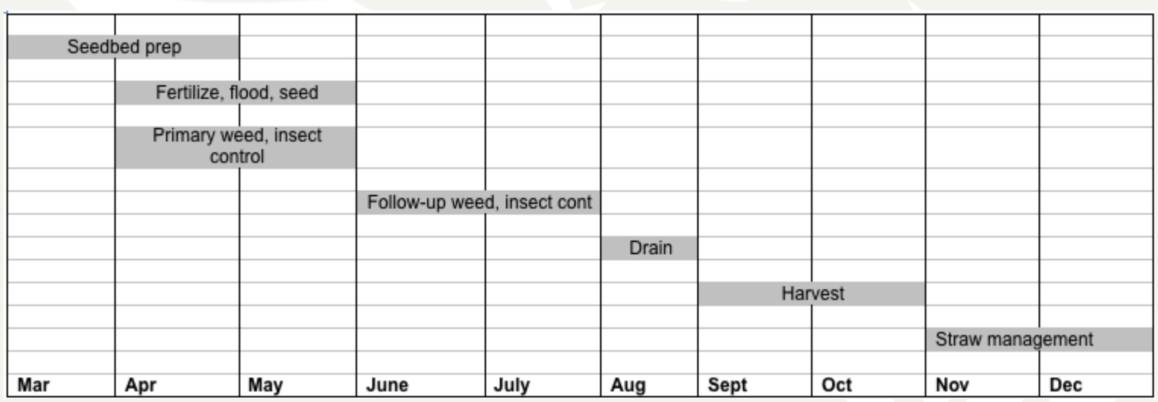
In the Sacramento Valley, the majority of rice is grown on clay soil primarily unsuitable for supporting other crops (CH2M Hill 1992.) Therefore, crop rotation is not common on rice ground. Approximately 98 to 99 percent of California rice is seeded in standing water at four to five inches deep. The field preparation and rice planting are weather dependent. Weather can delay the planting process, but there never is a time when the season starts early due to unusually dry conditions as the early planted rice becomes feed for late migrating waterfowl.

A. Field preparation

Water will be held on the harvested (non-crop period) rice fields over the winter months with draining starting at the end of February, first of March. The soil is disked to open up the top layer allowing it to aerate. Additional equipment is used to break-up the disked soil up into a finer, smoother texture. Preplant fertilizer is incorporated at this time. The fields are leveled to slopes of 0.05 to 0.1 percent. A grooved roller is pulled over the leveled field to create small rolls of ridges (UCCE/UCANR, Land Formation 2015).

Water is then added to the field at a depth of three to five inches. The rice seed is soaked in water 24 to 48 hours before planting. Soaking the seed starts the germination process and adds weight. The soaked seed is flown onto the field dropping through the water and settling into a groove formed during field preparation. Seedlings will break through the water and remain vulnerable to insect infestation, or dislodging until the plant tillers and begins forming the canopy (Attachment). Once the rice stand is established, the plant is naturally resistant to insect infestation (UCCE/UCANR 2015, Planting & Stand Establishment).

Figure 1. Calendar of operations



Source: CH2M Hill for the CRC Irrigated Lands Regulatory Program.
Note: The calendar is an approximation. Weather can delay the start of the rice season. However, the rice season never starts earlier than the dates on the chart. Follow-up insect control is for armyworm, which is a treatable population approximately once every five years.

B. Rice seeding

Approximately one to two percent of California rice is dry seeded. Dry seeding helps to break up the weed cycle due to the limited available herbicides with differing modes of action. Water seeding was developed for weed control, nitrogen nutrition and to increase productivity. The water is kept on the field throughout the season except for short-term drainage, permanently removing it only at the end of the growing season to prepare the field for harvest. Water depth is maintained at three to five inches for three or more months depending on the pest pressure to the crop.

California rice is most susceptible to damage during the first six weeks after seeding, the time it takes for the crop to set roots and break through the water. Growers refer to this critical time as stand establishment (UCCE/UCANR 2015, Planting & Stand Establishment; UCCE/UCANR 2015, Water Management).

Water seeding followed by water holds rice became an industry wide practice around 1982 (Div. of Ag. Sci. 1982). The initial rational was to allow the pre-germinated seed an opportunity to break the water surface in advance of the weeds for non-chemical control.

Whether rice growers water or dry seed, the number of plants per square foot can vary from 12 to 46 (UCCE/UCANR 2015, Planting and Stand Establishment). Minimum seedling population for maximum yield is dependent on many factors including sowing method, water management, planting date, rice variety and soil type (UCCE/UCANR 2015, Planting & Stand Establishment).

C. Waterholding requirements

Approximately 30 years ago, the rice industry initially collaborated with regulators and researchers to develop water-holding requirements that allowed the specific herbicides time for degradation to an acceptable level before release from a rice field. Over the course of ten years, researchers and plant breeders developed shorter stature rice varieties that could stand in shallower water and withstand water holding requirements up to 30 days.

Almost all rice pesticides have waterholding requirements either for degradation, efficacy, or both. The waterholding requirements for degradation are currently part of the environmental fate review of the pesticide registration process. Both the lambda cyhalothrin and zeta-cypermethrin labels include seven-day waterholding requirements.

III. Insects

Extensive information is provided on the insect pests to facilitate a better understanding of insecticide usage on rice fields. From seedling to the four-to-five leaf stage, insect pests can cause considerable harm to seedling rice. The early season insect pests include the rice water weevil (RWW), tadpole shrimp, crayfish and seed midge. The pyrethroids are labeled only for the RWW and seed midge.

The most common rice insecticide was carbofuran with the use cancelled and last reported in 2000 (U.S. EPA, DPR PUR). The next most common insecticide was methyl parathion with use dwindling down to zero by 2001 (DPR PUR). As previously stated, pyrethroid insecticides were first registered for use on California rice in 1999. The pyrethroids have become the most significant insecticide to California rice production due to lack of alternatives.

Seed midge hinders seedling establishment with several species in this group. Of this insect group, the adult resembles a small mosquito-like fly (they actually have no functional mouthparts so cannot bite like a mosquito), that is extremely mobile. Upon flooding a field, thousands of these adults arrive in a swarm and deposit eggs on the water surface. The eggs hatch in one to two days and the larvae feed on the soil surface of the flooded field. Larvae feed on seeds and seedlings as well as on algae. They often destroy the seed before it can germinate in the water. Seedlings three to four-inches long are not susceptible to midge damage (UCCE/UCANR 2015).

The most important invertebrate pest of California rice is the RWW. Adult RWW feed on the emerging leaves of the rice plant. The feeding leaves scars, but does not affect growth or yield. Coinciding with the feeding, the adults oviposit in the rice leaf sheaths. The oviposition occurs in the plants from two to six leaves. Eggs hatch in five to seven days; the first instar larvae feed on the leaf tissue for a few days and then drop down through the water and soil to the roots. The remaining portion of the life cycle is spent in the flooded soil of rice fields. The larvae develop through four instars and feed on rice roots where significant damage occurs (UCCE/UCANR 2015).

The effects of RWW injury on rice plant growth, development, and yield have been intensively studied by Dr. Larry Godfrey's laboratory since 1992. Results support an economic threshold of about one larva per plant. A linear relationship exists between the percentage of plants with adult feeding scars and larval density. Quantification of adult feeding scars is often used as a sampling tool to determine the necessity for chemical control (e.g., post-flood application of carbofuran primarily controlled the larvae of this pest).

Management of the RWW relies on chemical and cultural controls. Removal of the levee vegetation in the spring helps reduce RWW densities. However, growers are faced with the additional expense of herbicide treatments and the loss of critical wildlife habitat. Chemical control of the RWW relied on carbofuran from the late 1970's until 2000. The granular insecticide was applied before flood and soil incorporated to treat 35 to 40 percent of the rice acreage. Border applications became more common to cut expenses and target the area of the field were RWW densities occur (UCCE/UCANR 2015).

A. Treating the borders

The term "treat the borders" is commonly used in the California rice industry, but could cause concern to those unfamiliar with the practice. For typical insecticide pyrethroid applications, approximately 10 to 20 percent of the field is treated.

Pesticide labels include language that directs applicators to avoid application and drift into waterways, ditches and canals. Rice fields often consist of large acreage divided into smaller fields known as checks. Keeping the rice checks small allows for better water management and more direct pesticide application. The area separating the check is a berm made from compacted soil. The berm is also known as a levee. Using "levee" as common terminology can be confusing because levees are not inclusive of rice fields.

From conversations with aerial applicators and Dr. Luis Espino, Rice Farm Advisor, the following provides a description of boarder treatment:

Most applications of this type are one pass along the field border. Theoretically, that is 40 or 50 or 60 feet from the edge of the border (depending on boom width). Some growers ask for two passes, so that would be 80 or 100 or 120 feet from the border. However, when the insecticide hits the water (in the flooded field), it expands and seems to move up to 150 feet within the field (according to the applicators).

On levees separating the field checks, most aerial applicators fly on top of the levee, spraying both sides at the same time (20 or 25 or 30 feet each side). Applicators have the ability to turn off the center nozzles so that the levee itself is not sprayed. Most applicators are usually given material to spray 10 to 20 percent of the area of a field.

In general, 50 feet from border, 25 feet from levee, and the insecticide will move within the field once it mixes with the irrigation water in the field.

Note: Insecticide applications are typically early season before the rice plant is established. The scenario of treating the boarders with the flooded field irrigation water used for mixing would not apply after the plant is established with a closed canopy. The later season insecticide applications for armyworm are only necessary approximately every five years unless weather creates an unseasonal outbreak.

IV. Pesticide profiles and monitoring summary

In the initial stages of developing an Ag Waiver, known as the Conditional Irrigated Lands Regulatory Program (ILRP), the CRC completed profiles on the rice pesticides. The profiles were developed from data derived during the scientific evaluations for pesticide registration. Creating pesticide profiles provides a better understanding of the rice pesticides with monitoring augmenting the process.

The CRC was the only coalition to develop a Pesticide Evaluation, updated annually and provided to the Central Valley Water Board every five years. Our pesticide profiles predated the Pesticide Evaluation and the U.S. Environmental Protection Agency (EPA) Office of Pesticide Programs' Aquatic Life Benchmarks (freshwater) and Human Health Benchmarks for Pesticide (Attachment).

A. Pesticide profiles developed by the CRC at the onset of the ILRP

Pesticide Active Ingredient: cypermethrin
Pesticide Trade Name(s) (year 1st registered on rice): Mustang (2002)

Type of Pesticide: Insecticide from the pyrethroid family

Application Rates: 0.04 to 0.05 pounds of active ingredient per acre per application.

Mode of Action (target pests): Controls rice water weevil, seed midge and armyworm.

Aquatic Fate and Dissipation: See lambda cyhalothrin

Summary of Toxicity Studies for Wildlife:

Species	Acute Toxicity Value
Rat Oral, Female	LD_{50} 309 mg/kg
Rat Oral, Male	LD_{50} 247 mg/kg
Mallard Duck	LD_{50} >4640 mg/kg; Repro NOEC: 1000 ppm
Mallard Duck	8-days LD_{50} 20000 ppm
Bobwhite Quail	8-days LD_{50} 20000 ppm
Bluegill Sunfish	96-hrs LC_{50} 1.78 ppb
Rainbow Trout	96-hrs LC_{50} >0.92 ppb
Sheepshead Minnow	96-hrs LC_{50} >3.42 ppb
Daphnia magna	48-hrs LC_{50} >1.25 ppb
Honeybee	48-hrs LD_{50} >.31 micg/bee
Earthworm	14-days LD_{50} >1120 mg/kg

EPA Aquatic Toxicity Rating: Very highly toxic to many fish and invertebrate species.
EPA Avian Toxicity Rating: Slightly toxic to practically non-toxic.

<u>**Additional Information:**</u>

The label requires a 7-day waterhold.
Cypermethrin is a pyrethroid. Please see comments for lambda cyhalothrin.

Sources:

Summary of Toxicity Studies for Wildlife: *California Department of Pesticide Regulation, Pesticide Registration Branch*

Pesticide Active Ingredient: lambda cyhalothrin

Physical Property Data Related to Water Contamination Potential

Water Solubility: (Avg, mg/L) 0.0050

Adsorption Coefficient (Koc) 2,341

Hydrolysis Half-life (Avg, Days) 233.1

Aerobic Soil Half-life (Avg, Days) 61.8

Anaerobic Soil Half-life (Avg, Days) 128.0

Pesticide Trade Name(s): Warrior Insecticide with Zeon Technology (1999). Several trade names exist now that lambda cyhalothrin is off patent.

Type of Pesticide: Insecticide

Application Rates: 0.025 to 0.04 pounds of active ingredient per acre per application.

Mode of Action: Interrupts nerve impulse generation via impact on ion channel(s).

Target pests: Controls rice water weevil, seed midge and armyworm.

Aquatic Fate and Dissipation:

Prior to registration for use on California rice, field studies augmented the registration process. Results of the field studies show lambda cyhalothrin dissipates rapidly from the water column due to several factors. The primary one being the exceptional adsorption of the compound to sediment particles but it is also known that plants both strongly absorb and also degrade pyrethroids in aquatic systems. Once reaching sediment, the chemical is no longer significantly biologically available and also degrades moderately quickly to non-toxic degradates.

Lambda cyhalothrin can enter waterbodies via spray drift or in runoff as chemical is absorbed to sediment and organic matter. Field monitoring studies have been conducted in California to investigate residues of pyrethroids draining from the Colusa Basin and in the Sacramento River and low to non-detectable residues were recorded; the measured levels indicated that the freely available chemical in the water column was well below levels of biological concern. Moreover, additional monitoring studies were conducted at three sites in water bodies adjacent to rice fields sprayed aerially with samples taken within an hour of application; the studies showed no detectable residues in water or sediment.

Aquatic fate, dissipation (including pesticide half-life) are included in the scientific evaluation of the pesticide registration for rice pesticides. As a result, much is known about the effects of pesticides before the final stages of the registration process. We also know the rice farming practices; water management and soil types do not produce sediment in from the fields.

Summary of Toxicity Studies for Wildlife:

Species	Acute Toxicity Values
Rat Oral, Female	LD_{50} 56 mg/kg

Rat Oral, Male	LD_{50} 79 mg/kg
Mallard Duck	LD_{50} >3950 mg/kg; Repro NOEC: 30 ppm
Bobwhite Quail	Repro NOEC: 50 ppm
Mallard Duck	8-day LC_{50} 3948 ppm
Bobwhite Quail	8-day LC_{50} >5300 ppm
Bluegill Sunfish	96-hr LC_{50} 0.21 ppb; 36.3 ppm*
Rainbow Trout	LC_{50} 0.44 ppb; NOEC: 0.12 ppb; 13.3 ppm*
Flathead Minnow	96-hrs LC_{50} 0.70 ppb; NOEC: 0.34 ppb
Sheepshead Minnow	96-hrs LC_{50} 0.81 ppb; NOEC: 0.29 ppb
Daphnia magna	48-hr LC_{50} 0.36 ppb; 85 ppm*
Honeybee	48-hr LD_{50} 0.5 µg/bee
Mysid Shrimp	96-hrs LC_{50} 0.0041 ppb;

*=Metabolite: 3-phenoxy benzoic acid
EPA Aquatic Toxicity Rating: Very highly toxic to many fish and invertebrate species.
EPA Avian Toxicity Rating: Slightly toxic to practically non-toxic.

The lambda cyhalothrin label states "extremely toxic to fish and aquatic organisms". However, in practice, the aquatic eco-toxicity measured in clean water under laboratory conditions is not experienced in the field due to the adsorption and lack of bioavailability mentioned above. The pyrethroid class of chemicals (and lambda cyhalothrin in particular) has been investigated more thoroughly in the area of aquatic toxicity than any other set of insecticides in the last 15 years.

Comprehensive field and laboratory studies by industry and academic researchers have conclusively demonstrated that the biological activity of pyrethroids in the field reflects only that minuscule proportion that is freely dissolved in the water phase; chemical that is bound, while analytically detectable, is not biologically active.

Additional Information:

The label requires a 7-day waterhold.

<u>Sources</u>:

Summary of Toxicity Studies for Wildlife: California Department of Pesticide Regulation, Pesticide Registration *Branch*

B. Monitoring summary

The CRC completed the report, *Basis for Water Quality Monitoring Program: Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands for Rice (CWFR)*, October 1, 2004. Our intent was to develop a commodity specific ILRP from the decades of experience managing a prohibition of discharge program for five pesticides. The report tailors a program specific to rice by addresses all aspects of rice production including pesticide surface water monitoring and sediment studies from rice fields.

Pyrethroid surface water monitoring began on rice in 2004. We annually monitored zeta-cypermethrin and lambda cyhalothrin using the EPA Method 8081A and the approved method detection standards (<0.01 μg/L, LC_{50} 0.003 μg/L for lambda cyhalothrin and <0.008 μg/L, LC_{50} 0.012 μg/L for zeta-cypermethrin).

Additional pyrethroid monitoring took place during the initial stages of the algae toxicity monitoring. The monitoring and detection process was new for all parties involved, so the CRC did pesticide toxicity monitoring in advance of the algae toxicity testing to determine whether rice growing conditions and the pesticides applied were contributors. The EPA Method 8081A(s) with a MRL at 0.05 ng/μl resulted in non-detect. All pyrethroid monitoring results from rice practices were non-detect except for one result at 0.02 μg/L at the Colusa Basin Drain 5 on June 2005. The date of the detection coordinates with an unseasonal armyworm application.

As a result of the surface water monitoring and a more aggressive approach to algae toxicity, the current Rice Waste Discharge Requirements surface water program does not include pyrethroid monitoring unless toxicity is observed. The assessment monitoring collects water column toxicity samples for Green Algae *Selenastrum capricornutum,* Water flea *Ceriodaphnia dubia and* fathead minnow *Pimpehales promelas.* The sediment toxicity monitoring requires collection of sample for *Hyalella azteca*, sediment TOC and grain size. The two pyrethroid pesticides (s)-cypermethrin and lambda cyhalothrin are analyzed only if sediment toxicity is observed.

Knowledge from the amount of pyrethroids applied to rice fields, the application method, the fate and transport, the pyrethroid half-life, field dissipation, water holding requirements results in no negative impacts to wildlife inhabiting rice fields.

V. Impacts to waterfowl

California's rice fields provide sustenance for approximately half of the five million ducks and other waterfowl using the Pacific Flyway, a critical migration route. By some estimations, six percent of all the food consumed by wintering waterfowl in the Sacramento Valley comes from rice fields. (CRC 2012.) The Staff Report mentions the habitat seasonal wetlands and rice fields provide to migratory birds of the Pacific Flyway and fish species.

The CRC has a long history of evaluating impacts of rice farming practices, and several reports completed through partnerships with environmental and conservation organizations, and government programs such as the U.S. Fish and Wildlife Service and National Marine Fisheries Services.

Draining of rice fields begins in late August, if planting starts in mid-April (Fig. 1). The field drain is a slow process in preparation of harvest. The water moves slowly from the field leaving behind vegetation and sediment.

During rice harvest, the harvester leaves behind some spent grain. Less grain is available in the last decade due to improvements to harvesters that strip harvest the rice (Miller & Wylie 1996). The 2006 Central Valley Joint Venture Implementation Plan assumes that 349 pounds per acre of rice is available to waterfowl immediately after harvest (Miller et al. 1989). Moist-soil food resources average 25 pounds per acre in California rice fields (M.R. Miller, U.S. Geological Survey, unpublished data). This further increased the food density for rice habitat to 322 pounds per acre. Finally, the 30 pounds per acre foraging threshold established for wetland habitats was applied to rice, which reduced food density in this habitat to 292 pounds per acres. Although work in the Mississippi Alluvial Valley indicates that invertebrates average five to six pounds per acre in rice fields during the winter (Hohman et al. 1996, Manley 1999), invertebrates were not included as a food resource in the Central Valley due to uncertainty over the type, biomass, and seasonal availability of invertebrates in rice fields. As stated previously, insects are not a primary pest of California rice.

The rice straw remaining in the field can be baled and removed. If cut low enough, the straw is left in the field. Water is from either irrigation or rainwater is then added to the remaining stubble. Once wet, the stubble is rolled by a device called a stomper. The process helps to break up the rice straw for the winter decomposition process. More than one practice exists for incorporating rice straw. Rice fields remain flooded immediately after harvest until February or March at initiation of the winter drain (Fig. 1). The process for working fields starts over again.

The Sacramento Valley, as part of the Pacific Flyway, becomes home to migrating waterfowl during the winter when straw decomposition occurs. The migration into the Sacramento Valley begins around November and the return flight to the north ends around April – weather dependent. Managed wetlands become home to the waterfowl leaving the Sacramento Valley as late as April.

VI. Residue levels for rice

In the final stages of the registration process, the U.S. EPA establishes tolerance from the mandatory data including pesticide residue. The tolerance is the allowable residue of the specific pesticide on a food or feed commodity. “We set tolerances, which are the maximum amount of a pesticide allowed to remain in or on a food, as part of the process of regulating pesticides. In some countries tolerances are called maximum residue limits (MRLs).” ~ U.S. EPA, Office of Pesticide Programs

The tolerances for pyrethroids registered on rice are listed in the Federal Code of Regulation. Title 40: Protection of Environment. §180.418 Cypermethrin and isomers alpha-cypermethrin and zeta-cypermethrin; tolerances for residues. Rice, grain. 1.50 parts per million (ppm) and Rice, hulls 6.0 ppm. Title 40 Code of Federal Regulation lists §180.438 Lambda cyhalothrin and an isomer gamma cyhalothrin; tolerances for residues. Rice, grain. 1.0 parts per million (ppm) and Rice, hulls 5.0 ppm.

VII. Comments of prohibition of discharge and support of suggest values

The CRC is the one commodity with experience managing a prohibition of discharge known as the Rice Pesticides Program. Environmental and assessment monitoring began in the late 1970s through the early 1980s with the reporting complete in 1984. The process of managing rice field discharges began during that time with the first water hold established in 1982 (Div. of Ag. Sci. 1982). The Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Pyrethroid Pesticide Discharges set the performance goals for two herbicides in 1990 and the three insecticides followed in 1991.

Management of the Rice Pesticides Program was under the DPR, Environmental Monitoring Branch until the fall of 2002. The CRC was handed program management with the onset of the ILRP in 2003. We used the basis of the Rice Pesticide Program to build the foundation for a commodity based ILRP (implemented as the Waste Discharge Requirements) and a separate prohibition of discharge program.

From our experience managing water quality programs and our history of monitoring results we believe the 5th percentile is a more positive suggested value if there is a justifiable need to further regulate pyrethroid use in the Central Valley.

The CRC supports the Regional Board staff in utilizing the stakeholder process, and maintaining the procedure for an effective water quality program. Thank you for your consideration of our recommendations. Please contact me if you have any questions, or require additional information.

Sincerely,

Roberta L. Firoved

Roberta L. Firoved
Industry Affairs Manager

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List of Attachments

1. Rice pesticide Evaluation for zeta-cypermethrin and lambda cyhalothrin
2. Rice Growth Stage Chart – Rice Research Board

CHEMICAL	Aquatic Toxicity Values (ug/L) AQUIRE Data [a]		OFFICE OF PESTICICE PROGRAMS' AQUATIC LIFE BENCHMARKS µg/L (freshwater) µg/L (freshwater)								HUMAN HEALTH
			Fish		Invertebrates		Nonvascular Plants	Vascular Plants	Office of Water Aquatic Life Criteria		[b,h] Chronic or Lifetime HHBPs (Non-cancer)
	Value	Type	Acute [1]	Chronic [2]	Acute [3]	Chronic [4]	Acute [5]	Acute [6]	Maximum Concentration (CMC)	Continuous Concentration (CCC)	(ppb)
(s) or zeta-cypermethrin (CAS No. 52315-07-8)	0.889 1.0 55,200 0.5	96-hr LC_{50} (MOR MORT) Ceriodaphnia dubia (water flea) 48-hr EC_{50} (ITX IMBL) Daphnia magna (water flea) [LC_{50} MORT = 0.36] ug/L 24-hr EC_{50} (POP ABND) Scenedesmus acutus var. acutus (green algae) 96-hr LC_{50} (MOR MORT) Oncorhynchus mykiss (rainbow trout)	0.195	0.14	0.0018	0.00059	--	--	--	--	420

CHEMICAL	Aquatic Toxicity Values (ug/L) AQUIRE Data [a]		OFFICE OF PESTICICE PROGRAMS' AQUATIC LIFE BENCHMARKS µg/L (freshwater) µg/L (freshwater)								HUMAN HEALTH [b,b] Chronic or Lifetime HHBPs (Non-cancer)
			Fish		Invertebrates		Nonvascular Plants	Vascular Plants	Office of Water Aquatic Life Criteria		
	Value	Type	Acute [1]	Chronic [2]	Acute [3]	Chronic [4]	Acute [5]	Acute [6]	Maximum Concentration (CMC)	Continuous Concentration (CCC)	(ppb)
Lambda cyhalothrin (CAS No. 91465-08-6)	0.0041 0.04 0.24 0.3	96-hr LC_{50} (MOR MORT) Americamysis bahia (opossum shrimp) 48-hr EC_{50} (ITX IMBL) Daphnia magna (water flea) [EC50 MORT = 0.39 ug/L] 96-hr LC_{50} (MOR MORT) Oncorhynchus mykiss (rainbow trout) 48-hr LC_{50} (MOR MORT) Ceriodaphnia dubia (water flea)	0.105	0.031	0.0035	0.002	> 310	--	--	--	7

Footnotes for EPA Aquatic Life Benchmarks:

[1] Benchmark = Toxicity value x LOC. For acute fish, toxicity value is generally the lowest 96-hour LC50 in a standardized test (usually with rainbow trout, fathead minnow, or bluegill), and the LOC is 0.5.

[2] Benchmark = Toxicity value x LOC. For chronic fish, toxicity value is usually the lowest NOEAC from a life-cycle or early life stage test (usually with rainbow trout or fathead minnow), and the LOC is 1.

[3] Benchmark = Toxicity value x LOC. For acute invertebrate, toxicity value is usually the lowest 48- or 96-hour EC_{50} or LC_{50} in a standardized test (usually with midge, scud, or daphnids), and the LOC is 0.5.

[4] Benchmark = Toxicity value x LOC. For chronic invertebrates, toxicity value is usually the lowest NOAEC from a life-cycle test with invertebrates (usually with midge, scud, or daphnids), and the LOC is 1.

[5] Benchmark = Toxicity value x LOC. For acute nonvascular plants, toxicity value is usually a short-term (less than 10 days) EC_{50} (usually with green algae or diatoms), and the LOC is 1.

[6] Benchmark = Toxicity value x LOC. For acute vascular plants, toxicity value is usually a short-term (less than 10 days) EC50 (usually with duckweed) and the LOC is 1.

[9] The chronic benchmark is based on the acute toxicity value (which was lower than the lowest available chronic toxicity value), and therefore may underestimate chronic toxicity.

[10] Although the underlying acute toxicity value is greater than or equal to the chronic toxicity value, the acute benchmark is lower than the chronic benchmark because acute and chronic toxicity values were multiplied by LOC values of 0.5 and 1, respectively.

[14] The acute toxicity values were the lowest of the acid, salt or ester forms, and the chronic toxicity values were the lowest of the acid and salt forms of triclopyr. (Selection was consistent with risk quotients in the cited USEPA reference.)

Definitions

CCC = Criterion continuous concentration

CMC = Criterion maximum concentration

EC_{50} = 50 percent effect concentration

LC_{50} = 50 percent lethal concentration

LOC = level of concern

NOAEC = no-observed-adverse-effects concentration

µg/L = microgram per liter

— = no benchmark available

References

[a]Stephan, C.E, D.I. Mount, D.J. Hanson, J.H. Gentile, G.A. Chapman, and W.A. Brungs. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. EPA PB85-227049.

[b]U.S. EPA. 2004. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs. Office of Prevention, Pesticides, and Toxic Substances. Office of Pesticide Programs. Washington, D.C. January 23, 2004.

Human Health Benchmark Footnotes

b Formula for deriving Chronic HHBP = [cRfD (mg/kg bw/day) x BW (kg) x 1000 (µg/mg) x 0.2 RSC] / [Drinking Water Intake (L/day)] where BW=70 kg for general population and 66 kg for females 13-49 years and Drinking Water Intake = 2L/day for general population as well as for females 13-49 years and RSC = Relative Source Contribution assumed as 20%

h Represents the lowest benchmarks for the lifestage/population evaluated. In deriving the benchmarks, alternate bodyweights and drinking water intake may be considered for certain specific life stages (e.g., infants, children, pregnant mothers) and these could be found in the Exposure Factors Handbook 2011 Edition (1436 pp, 21MB, About PDF)

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